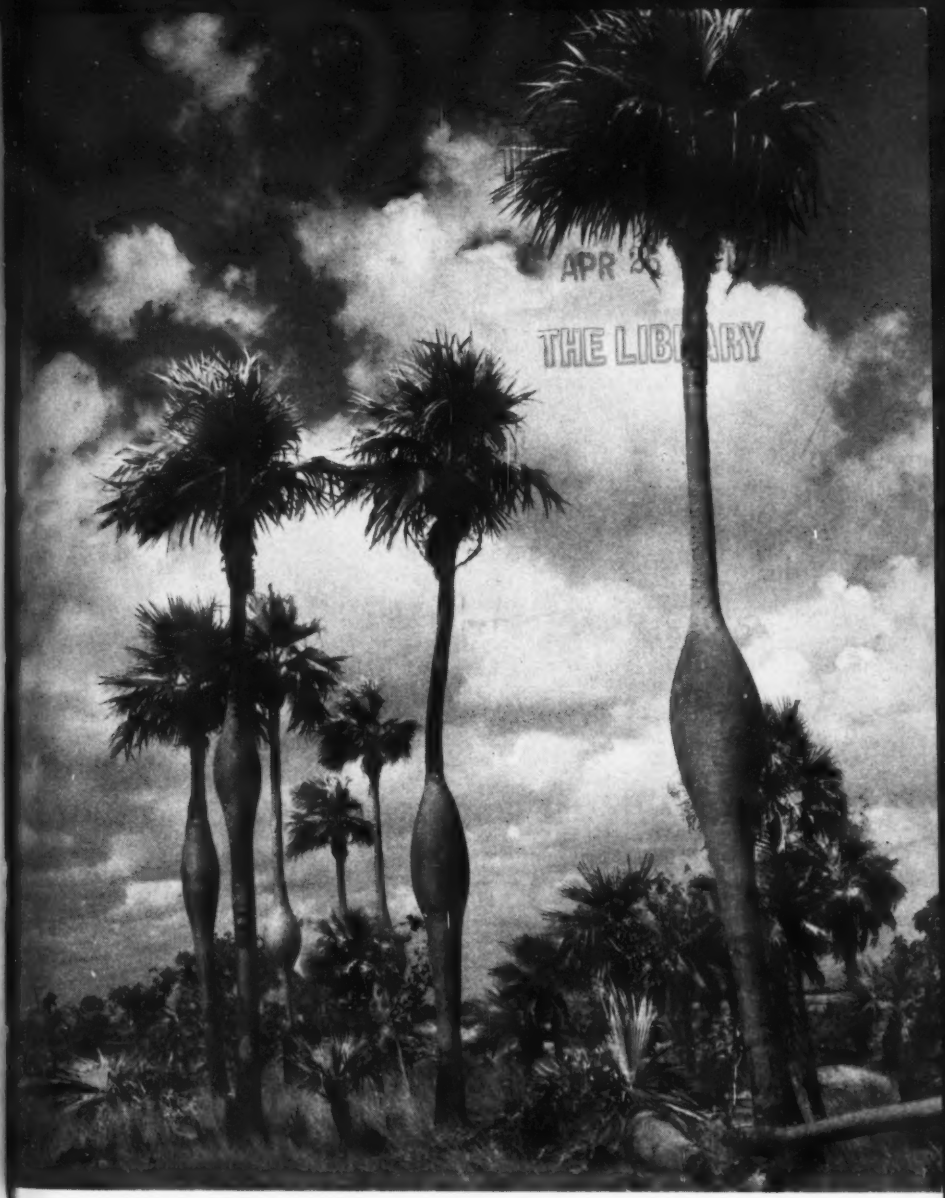
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PRINCIPES

Journal of The Palm Society

April, 1960
Vol. 4, No. 2

MAY 2 1960

THE PALM SOCIETY

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PRINCIPES

JOURNAL OF THE PALM SOCIETY

An illustrated quarterly devoted to information about palms published in January, April, July, and October, and sent free to members of The Palm Society

EDITOR: Harold E. Moore, Jr.

EDITORIAL BOARD:

Paul H. Allen, David Barry, Jr., Duncan Clement, Walter H. Hodge, Eugene D. Kitzke, Harold F. Loomis, Nixon Smiley, Dent Smith.

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Contents for April

Diseases of the Coconut Palm: VI
Yellow Mottle Decline (Cadang-Cadang)
M. K. Corbett 40

The Sago Palms
Jacques Barrau 44

The Cuban Belly Palm—
Colpothrinax Wrightii
Harold E. Moore, Jr. 53

Essays on the Morphology of Palms
I. Germination and the Seedling
P. B. Tomlinson 56

Gregório Gregorievich Bondar,
1881-1959 61

Oregon *Trachycarpus* and the Weather
Robert L. Bishop 69

Regular Features

News of the Society 39

The Editor's Corner 39

Palm Literature 63

In and Out of the Palm Garden . . . 64

What's In a Name? 67

Cover Picture

Colpothrinax Wrightii at Consolación del Sur, Pinar del Río, Cuba. Photograph by Nixon Smiley. See also pages 53-55.

NEWS OF THE SOCIETY

Death of Three Members

We have to announce, with regret, the passing of three Society members: Mr. Charles I. Minkoff, of Miami, Florida, Mr. Ralph S. Peer, music publisher and camellia enthusiast, of Los Angeles and Mr. Fred E. Low, nurseryman, of Vista, California. The Society extends its deepest sympathy to their families. Mrs. Low is continuing her late husband's membership in the Society.

Contributions

Due to the change-over in treasurers, there has been some delay in sending out renewal notices. We are grateful to those members who have sent their contributions even if they have not received notices. Mr. John Turner, treasurer protem, hopes soon to have notified all those whose contributions are now renewable, but please do not wait if you think it is time to send a new contribution.

Handbook of Palms

The American Horticultural Society, which had planned to publish the Handbook of Palms (possibly under another title) in January, 1960, has been forced to postpone its publication, due to the untimely death of Dr. Bruce Ledin, and other factors. The American Horticultural Society has recently merged with the American Horticultural Council, retaining the name of the senior organization, but changing the name of its publication from *National Horticultural Magazine* to *American Horticultural Magazine*.

Dr. Walter H. Hodge, president of The Palm Society and chairman of the Editorial Committee of The American Horticultural Society, reports that the following motion was passed by the new Board of Directors of the Society:

"That the Palm Handbook manuscript be left in its original suggested form of 192 pages of text and illustrations, that it be published as the January, 1961, issue of the *American Horticultural Magazine*, that the Magazine be made available at the time of the American Horticultural Congress to be held in California in November, 1960, and then issued to the members as stated above."

This is indeed good news, since our Society, young as it is, does not have the funds to publish such a volume. Sponsorship by such an eminent group as the American Horticultural Society is a real honor for our Society.

Continued on page 68

THE EDITOR'S CORNER

Those of us who live in highly industrialized countries seldom realize to what extent palms are important in the daily lives of peoples in some less-developed tropical lands. Dr. Jacques Barrau of the South Pacific Commission in Nouméa, New Caledonia, has written an article that deals with one aspect of this subject and also includes some notes on the genus *Metroxylon*. We reprint the major portion of his article in this issue with permission. Dr. Barrau hopes eventually to extend his work to a more detailed study of the genus which badly needs attention. For lack of better, Dr. Barrau follows the nomenclature used by Beccari, some of whose names are not in accordance with present-day requirements.

Another man who worked with palms affecting man's economic life was Dr. Gregorio Bondar of Brazil whose death a year ago was a loss to both botanists and entomologists. Dr. Klare Markley and Dr. Bondar's daughter have between

Continued on page 53

Diseases of the Coconut Palm*

M. K. CORBETT

Plant Pathology Department, University of Florida cooperating with the State Plant Board of Florida, Gainesville, Florida

VI. YELLOW MOTTLE DECLINE (CADANG-CADANG)

The sixth disease of coconut palms to be considered in this series is yellow mottle decline *(cadang-cadang)* which is probably the most serious threat to coconut production in the Philippines (3, 6). It is indeed fortunate that the disease is presently restricted to the Bicol Peninsula of Luzon and some of the nearby islands (3, 6). *Cadang-cadang*, a Bicol word, meaning "to die" or "dead," has come to be associated with the yellowing or growth failure of any plant in the Philippines and, because of this, the name yellow mottle decline was suggested by Price (6) to distinguish this disease from others of a somewhat similar appearance. All information concerning this disease that is to be presented here has been obtained either from the literature or through personal communication with workers who have investigated the problem in the Philippines.

Rather extensive research programs have been initiated to study the disease, but investigators have been confronted with the problem of a lack of basic information concerning the coconut palm and, consequently, knowledge about its etiology and control is meagre. Although the disease was first reported by growers to have occurred in two regions of the Bicol Peninsula as early as 1914-1919 (3, 6), the first published report of the yellow mottle decline type of *cadang-cadang* is that of Ocfemia from San Miguel Island in 1937 (4). At that time he reported approximately 25 per cent of the trees in certain areas to be affected. Since then, the disease has destroyed nearly 80 per cent of the trees (3, 6) on the island and has spread to all provinces of the Bicol Peninsula (7). To determine the exact location where the disease made its first appearance is difficult, but Price (6) assumes from the available evidence that the disease first appeared on San Miguel Island and has since spread to its present limits.

Yellow mottle decline, like many of the diseases that occur in the Caribbean islands, is difficult to distinguish in certain cases. There are, however, characteristic symptoms that help to distinguish it from other coconut maladies. The pinnae of the young leaves exhibit yellow to orange spots which enlarge to form the yellow mottle or mosaic of the older leaves (6). The mottling is more pronounced when viewed by transmitted light (3, 6). When viewed by reflected light, so-called "water-soaked" spots can be seen on the under surface of affected leaves (W. C. Price, personal communication). When viewed at a distance, this mottling imparts to the lower two thirds of the crown a yellowish to bronze appearance. The top third of the crown remains green or sometimes even darker green than normal (1, 3, 4, 7). Price (6) draws attention to the bronzing or yellowing of the secondary veins of affected pinnae. He considers this bronzing of the veins to be diagnostic of the

*For previous articles in this series, see PRINCIPES. 3:5-12; 49-52; 83-86; 117-120. 4:6-9. Florida Agricultural Experiment Station Journal Series, No. 849.

23. Medium and late stages of yellow mottle decline (*cadang-cadang*), Bicol Peninsula, Philippine Islands. Photograph by W. C. Price.

yellow mottle decline, but cautions that such a symptom may occur from other causes. In advanced stages of the disease the fronds become brittle and stunted. The leaves dry out and tend to drop faster than new ones appear; thus there is a gradual reduction and eventually only a tuft of small upright green leaves remains (figure 23) (3, 4, 6, 7). The disease progresses until there are only a few short heart fronds left. In two to seven years the growing point finally dies, leaving a crownless trunk (3). Figure 24 illustrates the advanced symptoms of the disease and its devastating effect on a coconut plantation. As the crown is reduced, the trunk exhibits symptoms of tapering towards the crown, especially if the tree is affected before flowering (3, 6, 7). Although tapering occurs to a slight extent, severe tapering of the stem is an exception rather than the rule (Price, personal communication). According to Price (6), trees that have been affected about one year with the yellow mottle decline start to show symptoms of the disease in the fruit. The fruits tend to lose their triangular shape, becoming more rounded at the base. The nuts are smaller and the number produced decreases until production ceases. The smaller fruit size in the early stages of the disease is due to a reduction in the thickness of the husk (6). The nut itself eventually becomes smaller as the disease progresses (figure 25) (6). Another symptom considered by Price (6) to be characteristic of the disease is the scarifications on the husks of diseased fruit. The scarifications are dark brown or black, often encircling the fruit, and are more extensive than those caused by mechanical or insect damage (fig. 25).

24. Coconut plantation in advanced stages of yellow mottle decline (*cadang-cadang*) in the Philippine Islands. Note devastating effects of the disease. Area has been replanted with rice. Photograph by W. C. Price.

Soon after the fruits have developed symptoms, the inflorescences begin to show effects of the disease. The female flowers are affected earlier than the male flowers. They either fail to set fruit or the fruits which are set abort before maturity. In late stages of the disease the palm may produce only male flowers on short branches of the inflorescences. Production may cease entirely three to four years after the first appearance of symptoms (3, 4, 6, 7). Price (6) draws attention to the effect of the disease upon the inflorescence and its use for making *tuba* (fermented sap extracted for manufacture of alcohol). Since the inflorescence is used in the making of *tuba*, the diseased palm loses its value for this as well as for the production of copra.

The milk from nuts formed on diseased trees tastes normal (3). Buds *(ubod)* from diseased trees tend to be quite sweet (7) and are in demand by the Filipinos who consider them a delicacy (6). The disease was once thought to affect only palms of bearing age but recently four-year-old trees have been observed to be infected with yellow mottle decline (6). Kent (3) reports that diagnosis of the disease in palms before bearing age is difficult due to lack of the distinguishing characters of fruit-drop, tapering stem, and crown symptoms. According to Price (personal communication), diagnosis of the disease in young trees should be based on the presence of yellow spots and water-soaked spots on the pinnae.

The etiology or cause of the yellow mottle decline, like that of some other diseases of coconut palms, is unknown. Several theories have been proposed but at present the causal agent has not been definitely determined. Celino (2) reported mechanical transmission by pricking with fine needles through diseased and healthy fronds. The inocu-

25. Fruits from a palm affected with yellow mottle decline (*cadang-cadang*) on the right. Fruit from a healthy palm on left. Note reduction in size and surface scarifications on fruits from affected palm. Photograph by W. C. Price.

lated seedlings, however, did not develop the yellow mottle decline symptoms normally associated with *cadang-cadang*. Attempts to isolate infectious organisms such as fungi, bacteria, or nemas from diseased material have not been successful (6). The effects of insect feeding have been given consideration but spray programs on diseased trees have not resulted in any diminution of the disease (3, 6, 7).

The two theories at present receiving the greatest attention are those of nutritional imbalance and virus (8). The virus hypothesis was first proposed by Ocfemia in 1937 (4) and seems at present to be in favor. Although definite evidence of transmissibility is lacking, the circumstantial evidence (pattern of field spread, lack of visible pathogen, infectious nature of the disease, spotty distribution, healthy and diseased trees growing side by side) strongly supports the virus theory and detracts from the theory of nutritional imbalance.

In the absence of information with respect to the causal agent, it is not possible at this time to offer definite advice on control of yellow mottle decline. Several writers (2, 3, 6, 8) have stated that there is no record of the recovery of a palm from this disease and have recommended that infected trees be removed. Ocfemia (5) recommends spraying both diseased and healthy palms in the vicinity with an insecticide, after which the diseased trees should be removed and burned. Kent (3) recommended that, since little is known of the relation between the disease and other plants, the practice of clean cultivation should be observed.

Acknowledgements

Grateful acknowledgments are made to the State Plant Board of Florida for making this study possible, to Miss Jean Smith for assistance with illustrations, and to Drs. W. C. Price and G. C. Kent for illustrations and valuable information concerning the disease.

Literature Cited

1. Celino, M. S. 1947. A Preliminary Report on a Blight Disease (Cadang-Cadang) of Coconut in San Miguel Estate, Albay Province. *Philippine Journal of Agriculture* 13: 31-35.

2. Celino, M. S. 1949. Progress Report on Experimental Transmission of Cadang-Cadang Disease of Coconut. *Philippine Journal of Agriculture* 13: 109-111.

3. Kent, G. C. 1953. Cadang-Cadang of Coconut. *Philippine Agriculturist* 37: 228-240.
4. Ocfemia, G. O. 1937. The Probable Nature of "Cadang-Cadang" Disease of Coconut. *Philippine Agriculturist* 26: 338-340.
5. Ocfemia, G. O. 1950. Measures Suggested for the Control of the Infectious Form of Cadang-Cadang Disease of Coconuts. *College of Agriculture Biweekly Bulletin* 15 (1): 1-2.
6. Price, W. C. 1958. Report to the Government of the Philippines on the Yellow Mottle Decline (Cadang-Cadang) of Coconut. *F. A. O. Report No. 850.* pp. 1-57.
7. Reinking, O. A. 1950. Preliminary Report on the Cadang-Cadang Disease and on Soil Deficiency Troubles in the Philippines. *Plant Disease Reporter.* 34: 300-304.
8. Scharpenseel, H. W., Bigornia, A. E., and S. Balce. 1955. Investigation on the Etiology of the So-called Cadang-Cadang Disease of Coconut Trees. *Araneta Journal of Agriculture.* 2 (3): 15-27.

The Sago Palms

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[Reprinted with permission of the author and publisher, the original figures renumbered, from a longer article entitled "The Sago Palms and Other Food Plants of Marsh Dwellers in the South Pacific Islands," *Economic Botany* 13(2): 150-162. 1959.]

Marshes occupy wide areas in the continental islands of the South West Pacific. Among the vegetation types prevailing in such an environment are the swamp forests. These are composed of mangrove trees (*Bruguiera, Ceriops* and *Rhizophora* spp.) where the water is brackish and of sago palms (*Metroxylon* spp.) or other species, such as *Terminalia brassii* Exell in the Solomon Islands, where the water is fresh.

Needless to say, the possibilities of subsistence horticulture in these waterlogged surroundings are quite limited. Nevertheless, in some areas, for the most part in New Guinea, the marsh dwellers have evolved fairly elaborate techniques to grow the few edible plants which supplement their diet (Barrau, 1).

The purpose of the present article is to describe a few of the food plants characteristic of these swamp areas which are their natural habitat. As a matter of fact, some of these plants are the objects of foraging and not of proper cultivation.

The Sago Palms

The sago palms belong to the genus *Metroxylon* Rottböll. They are particularly abundant in the swampy lowlands of New Guinea where they form huge forests. The Papuans who live there use as a staple the starch which they extract from the stipe's pith.

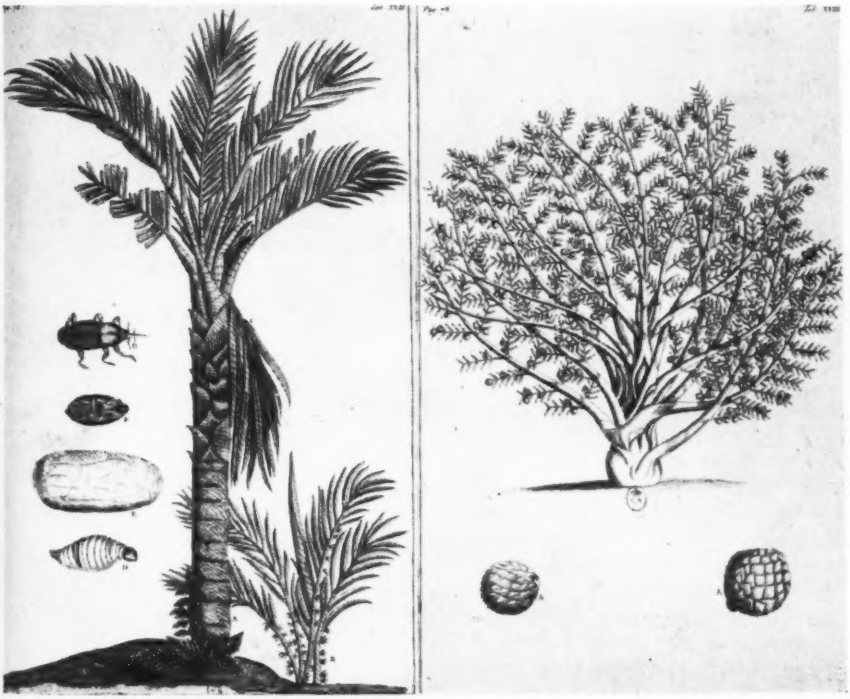
The species of the genus *Metroxylon* are arborescent, monoecious palms, often more or less thorny. The columnar stipe reaches generally from 25 to 30 feet in height; the leaf petioles have a widened base clasping the stipe without ensheathing it. These are strong and, according to the species and varieties, either inerm or thorny. The leaflets are straight, acuminate, ensiform, with acerate margins which, in some cases, are spinulous. The inflorescence

is an enormous raceme protruding at the tree's top from the center of the leaf crown. It appears at the end of the tree's life. The lowest part of this inflorescence is ensheathed in a tubular spathe, as are the secondary ramifications which bear alternate catkin-like spikes on which are densely grouped the flowers set out by pairs—one male and one female—in a spiral. These flowers have membranous bracts and villous bracteoles, the latter being sometimes reduced to a tuft of hairs. The fruit—globulous, turbinate, egg-shaped or pyriform, according to the species and variety—is covered with scales set out in vertical series and contains a seed often hard enough to be used as a source of vegetable ivory.

The nomenclature presently used for the *Metroxylon* species is that of Beccari (2) who in 1918 described and classified all the then known forms of sago palms. If one follows this author, the *Metroxylon* species occurring in the islands of the South West Pacific are classified as follows:

A. Section *Eumetroxylon*: fruit covered with scales set out in 18 vertical series:

I. Petioles and spathes inerm: *M. sagus* Rottb. (syn. *M. inerme* Mart., *M. laeve* Mart., *Sagus genuina* Gisk., *S. inermis* Roxb., *S. laevis* Rumph.)



26. Two drawings from Rumphius' *Herbarium Amboinense*, 1741-1756. (left) A sago palm with the adult and immature stages of a weevil which frequently attacks this species. Larvae found in rotten sago palm stipes are frequently eaten by the natives. (right) The inflorescence and fruits of sago palm. (Photograph Bibliotheque Nationale, Paris).

II. Petioles and spathes more or less thorny: *M. rumphii* Mart. (syn. *Sagus genuina* Rumph., *S. rumphii* Willd., *S. spinosus* Roxb.)

B. Section *Coelococcus*: fruits covered with scales set out in 24-28 vertical series:

I. The inflorescence is not a raceme erected at the tree top, but axillary panicles appear between the petiole bases: *M. amicarum* Becc. (syn. *M. carolinense* Becc., *Coelococcus amicarum* Warb; *C. carolinensis* Dingl., *Sagus amicarum* Wendl.)

II. The inflorescence is a large raceme erected at the tree top.
   a) fruit obpyriform to turbinate
      i) 10-12 cm. in length, 7-8 cm. in width: *M. warburgii* Heim (syn. *Coelococcus warburgii* Heim).
      ii) 3-4 cm. in length, 2-3 cm. in width: *M. upolense* Becc.
   b) fruit globulous or egg-shaped, 5-6 cm. in length, 4-6 cm. in width: *M. vitiense* Benth & Hook. (syn. *Coelococcus vitiensis* H. Wendl., *Sagus vitiensis* H. Wendl.)

III. Fruit globulous, more or less flattened down:
   a) 7 cm. in diameter, base not concave: *M. salomonense* Becc.
   b) 5-6 cm. in diameter, base concave: *M. bougainvillense* Becc.

The map in fig. 28 shows the distribution of these species in the South Pacific area.

Probably this classification is not entirely valid.

In the section *Eumetroxylon* (to which belong the two species, *M. rumphii* and *M. sagus*, frequently used as sustenance plants) Jumelle (3) draws the attention to the following facts: the fruits of *M. rumphii* or of *M. sagus* can give birth to seedlings either thornless or thorny. As a matter of interest, the Marind Papuans, who live in the swamp, most southern part of Netherlands New Guinea where huge stands of these species occur, claim that in any of the

27. Flowering *Metroxylon vitiense* in the collection of Naduruloulou Plant Introduction Gardens, Viti Levu Island, Fiji Group. (Photo J. Barrau).

forests of thorny sago palm (*M. rumphii*) they have found thornless seedlings which they planted near the villages, thereby establishing groves of *M. sagus*. In this part of New Guinea, one can find among the wild sago palms all intermediate forms between a thorny *M. rumphii* and a thornless *M. sagus*. Beccari (2) himself wrote that the two species were "barely distinct."

Mention should be made that this author has at times described new species of *Metroxylon* on the basis of fragmentary specimens. Such was the case of his *M. upolense* of which, he wrote, he saw only *one* fruit.

Nevertheless, the sections he has erected on the basis of the number of

scale series covering the fruit seem to be sound. However, *M. amicarum* raises another problem. Should this sago palm be kept in the genus *Metroxylon* or segregated from it and placed under the old generic name *Coelococcus?* Some botanists such as Kanehira (4) and Glassman (5) were apparently in favor of this segregation. The point is that the peculiar inflorescence of this palm and the fact that it bears fruits during the tree's life differentiate this species from the others which have, as indicated above, an erected racemose inflorescence appearing at the top of the tree when it reaches the end of its life. Further investigation is needed to judge the exact value of this character as a possible criterion to segregate *M. amicarum* from the genus *Metroxylon*.

To complete this taxonomic discussion, one must mention that Burkill (6) suggested keeping in the old genus *Coelococcus* all sago palms growing in the South Pacific islands other than New Guinea. It is difficult to follow this proposal as the number of scale series of the fruit alone does not appear to be a sufficient criterion to do so.

Coming back to the distribution of the *Metroxylon* palms in the islands of the South West Pacific, it is of interest to underline the fact that species of the two sections *Eumetroxylon* and *Coelococcus* occur in New Guinea and the Bismarck Archipelago, where sago palms very similar to *M. salomonense* are found.

Beccari (2) was of the opinion that the *Metroxylon* has its center of origin in the Moluccas where another species, *M. squarrosum* Becc., occurs. It could very well be that this center includes the nearby sub-continent of New Guinea where huge natural forests of *Metroxylon* are found. Although we are far from knowing all the forms of *Metroxylon* occurring in this territory, present knowledge indicates that they are quite numerous and include a wide range of species and varieties (perhaps nearly all the species of *Metroxylon* described by Beccari).

In New Guinea, the sago palms are known under the following vernacular names: Abia, Aiasi, Akiri, Ambe, Api, Baiao, Balega, Barian, Da, Dou, Fi, Ipako, Na, Nafa, Ndana, No, Poi', Pu, Wariani. In the pidgin English used by the Papuans, they are called Saksak.

The natives of the New Hebrides called sago palms Natangora. On the island of Rotuma, its name is Ota or Oat, according to Bennett (7), while in the Fiji Islands, it is Soqo or Soqa. The last name could be a local modification of Sago.

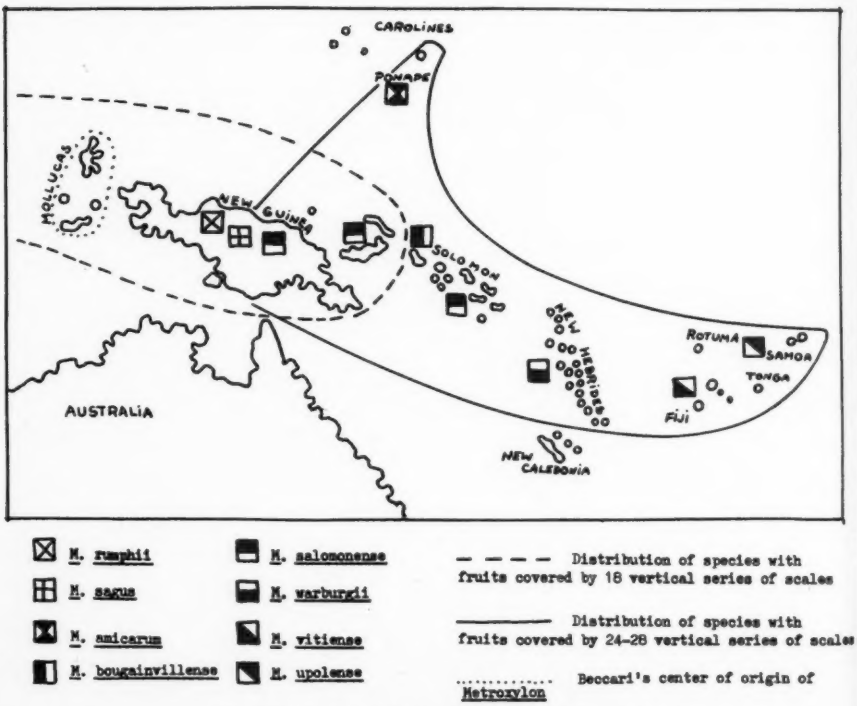
The sago palm is known as Lapia in the Moluccas, and as Rambia, Rembia, Rembi, Rumbia and cognates in Indonesia.

It is mainly in New Guinea and the neighboring islands that varieties of *Metroxylon* are used for their starch content. In other territories where these palms exist, for some unknown reason their use as a food was discontinued long ago. Guppy (8) believed that the use of *Metroxylon vitiense* as a subsistence food was thus lost in Fiji. In the New Hebrides, where the people know only through tradition of this use of sago as food, today one comes across varieties of *Metroxylon* valued for their leaves only, which are used in house building. It is possible that in some distant epoch species of the *Metroxylon* group, whose center of origin spreads from Indonesia to New Guinea, were transported by men right to the borders of what is at present known as Polynesia.

In New Guinea, the islanders use the natural groves and also grow sago palms propagated by seedlings and suckers. Eight to fifteen years are required before the palm tree is worth felling, as it is just before flowering that the reserves of starch stored in the trunk are at their maximum. To prevent flowering exhausting these reserves, the Papuans occasionally remove the bud. Naturally sterile palm trees which accumulate enormous amounts of starch in their trunks are also found, and as much as 900 lbs. of crude sago has been extracted from such palms. This, however, is exceptional and the average yield is very much lower.

Mr. Zwollo, of the Department of Agriculture, Hollandia, Netherlands New Guinea, to whom I am indebted for much of my information on the sago palm, places the average yield at 250 to 350 pounds per tree. (Mr. Zwollo has produced for the Netherlands New Guinea administration a remarkable study, entitled "Sagoe Onderzoek," which is devoted to the sago palm and its uses. Unfortunately, this interesting work is unpublished.)

In a normal swamp forest grove there will be some 25 palm trees per acre per year which are worth felling. These will produce between 6,250 and 8,750 lbs. of crude starch, with a water content of between 35 and 40 per cent, which represents roughly food value of 7,000,000 to 10,000,000 calories. *Metroxylon* yields however, vary considerably; certain



28. Distribution of *Metroxylon* species in Oceania.

varieties are particularly poor in starch, and it is possible to find dense groves of *Metroxylon* containing only trees with a very low sago production.

In a given area of swamp forest, the local people recognize a number of varieties of sago palms; for example, the Marinds of Netherlands New Guinea distinguish at least eight smooth or more or less thorny varieties with added variations in size, color, growth, and starch yield.

The starch or sago is extracted from the palms in the following manner. After felling, the bark is removed from half of the sago trunk. The pith is removed by grating and crushing with a kind of adze of which the cutting section is made of rough stone, hard wood, or more often, from a piece of sharpened bamboo. Today, where there is contact with the Europeans, a section of metal piping with sharpened edges is frequently substituted for the stone or wood tools.

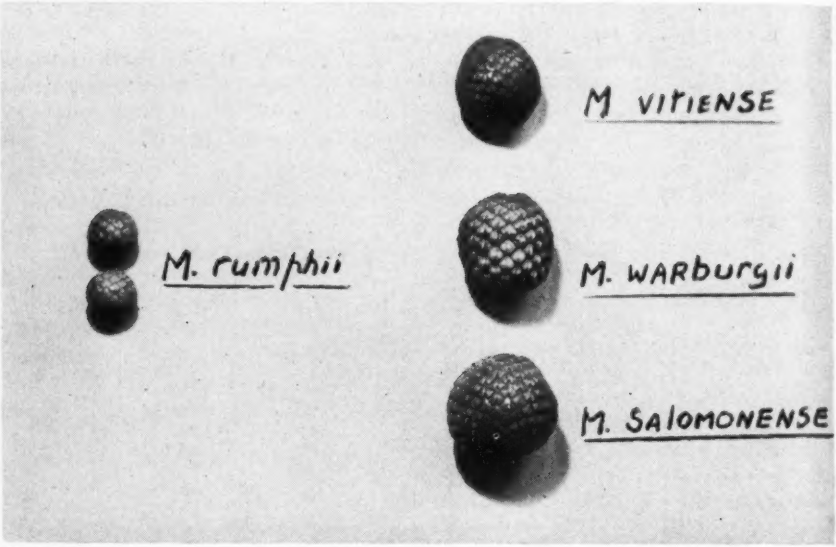
The crushed pith is washed in an inclined trough, made from a leaf of the sago palm. This process is accompanied by threshing with a lath or kneading by hand. The liquid containing the starch runs into the trough, filters through a fibrous spathe arranged for this purpose, and is collected in draining pans made from portions of the palm (leaves, leaf stalks, etc.).

The drained sago is then partially dried and wrapped in bundles with palm leaves. These bundles vary in form but are most often cylindrical or conical. If the sago is intended for family consumption only, the bundles are more or less shapeless. Those intended for barter, however, are prepared with particular care. In New Guinea, the natives hollow out cylindrical holes in the fibrous residue left from the washing process and line them carefully with green *Metroxylon* leaves. They then heap the fresh starch into the hole, using it as a mould; and after wrapping the leaves over the top, they remove the package and bind it fast.

Bartering of sago gave the marsh dwellers in New Guinea the opportunity to procure articles which they lacked, such as pottery, tools, smoked fish, and other foods, notably tubers. This trade entailed real sea-going expeditions, such as those made by the natives of the Port Moresby district travelling to the western deltas to acquire supplies of sago. Even today, intensive canoe traffic continues to ply between the islands in the Geelvinck Bay and the Waropen marshes in Netherlands New Guinea.

Industrialized cultivation and commercialization of sago might afford a desirable improvement in the living conditions of natives inhabiting the swamp forests, where economic possibilities are limited. Although the starch produced by native methods is impure, it might well become an export product. As a matter of fact, a sago factory for export has recently been established in the Radja Empat Islands, in the most western part of Netherlands New Guinea. Additional evidence that this product can be of considerable export value is shown by the fact that in 1950 the United States imported some 6,000,000 lbs. of sago from Malaya and Indonesia.

In order to preserve the sago they produce, the natives find it sufficient to keep it damp in a covering of leaves, sprinkling it with water from time to time. Where pottery is known, the fresh sago is merely placed in a large jar and covered with water. In some cases, a sago paste is made into briquettes, which are dried rapidly on the surface over a fire. These briquettes keep for about a



29. Fruits of four species of *Metroxylon* found in the South Pacific islands. Photo L. Devambez and J. Barrau.

month. As a general rule, the Papuans find that when sago is completely dried it loses its flavor. They consider the starch thus prepared by European methods as being practically inedible.

An examination of a number of food composition tables shows that sago consists almost entirely of starch and water (cf. Massal & Barrau, 9). The protein content is very low, in the region of 0.2 g. per 100 g.; fats are completely absent. Mineral salts are present only in very small quantities (ash, 0.35 mg. per 100; calcium, 10 mg.; phosphorus, 12.5 mg.; iron 1.5 mg.). There are practically no vitamins. Nevertheless, it is possible that the fermentation process which develops when sago is preserved in the wet state increases the vitamin B content. The water content of sago varies considerably depending on the methods of preservation used by the natives. The calorie value varies in relation to the water content and should be calculated according to the starch content of each sample.

In the South Pacific Commission laboratory in Nouméa. Mr. Frank Peters analyzed several samples of sago, or preparations made from sago, from Netherlands New Guinea. The results obtained and, in each case, the value of the constituent elements of the fresh and dried product, per 100 grams of the product are given below.

All the samples were collected in Netherlands New Guinea.

These results call for no particular comment. They indicate clearly the variations in water content of sago preserved according to native methods and coincide with results already known.

Sago can only supply energy needs. In swamp regions of New Guinea where sago is the staple food, the average daily

Analysis of Sago Samples made in the South Pacific Commission Biochemistry Laboratory by Mr. F. E. Peters:

Description	Water	Ash	Fibre	Starch (Acid Hydrol.)	Free Reducing Sugars	Ether Extract	Total Nitrogen	Nx625
Raw Sago	27.0	0.1	0.3	71.0	Nil.	Nil.	Trace	.....
Sago Senole[a]	23.0	0.5	1.0	59.0	0.5	16.5	0.30	2.0
Sago Ega[b]	37.5	0.5	1.8	53.0	0.5	Nil.	0.1	0.5
	52.5	0.5	0.6	40.0	0.5	Nil.	Trace	.....
Sago Lempeng[c]	12.0	0.3	0.2	84.0	Nil.	Nil.	Trace	.....
Sago Bulu[d]	55.0	1.5	1.0	39.0	1.0	1.0	Trace	.....
Sago Boengkoes[e]	42.0	0.5	0.5	53.0	0.2	2.0	Trace	.....

[a] Common preparation made from a mixture of sago and grated coconut, shaped into a flat cake and baked.

[b] Sago paste preserved in briquette form, wrapped in sago leaves.

[c] Sago biscuits.

[d] Sago paste cooked in a green bamboo.

[e] Roasted stick of sago paste.

ration for an adult is about two lbs. This ration varies, according to Zwollo, from between 1½ to 3½ lbs. of raw sago and represents 1,700 to 4,000 calories. It is considered that, in order to satisfy its needs, the average family must spend around ten days per month in sago groves. As sago is an unbalanced foodstuff, it must necessarily be supplemented.

Within the ecological environment of the New Guinea swamp forest, animal and vegetable protein, fats, minerals and vitamins are supplied mainly by foraging. *Ipomaea aquatica* Forsk. leaves and other greens take the foremost place, while the products of fishing and hunting are of secondary importance. Fresh vegetables are grown on platforms or in the gardens on the limited areas above water. On the edge of the swamp forest or in savannah districts dotted with sago swamps, the diet is supplemented by tubers, roots, greens, and pulses from the gardens and by coconuts and by hunting.

Sago is eaten in various ways. Where pottery is known, a sago porridge accompanied by condiments and greens, fish, shellfish, or wild meat is the most popular form. Where pottery is not known, a kind of cake is generally made by cooking a sago paste, occasionally mixed with grated coconut, greens, fish, or meat in an oven of hot stones. This paste is cooked either rolled in green leaves, in half a coconut shell, or in a section of bamboo.

In districts of Netherlands New Guinea where pottery is used, a kind of biscuit known in Malay as *sagoe lempeng*, which is easily preserved, is made in an earthenware mould which serves as an oven.

Thus by exploiting natural or cultivated plantations of sago palms, the dwellers in the swamp forests of New Guinea obtain this energy food which is the basis of their diet. Moreover, through barter sago makes it possible for them to acquire a limited quantity of goods, local or imported, which are becoming daily more necessary for their existence in this ill-favored area.

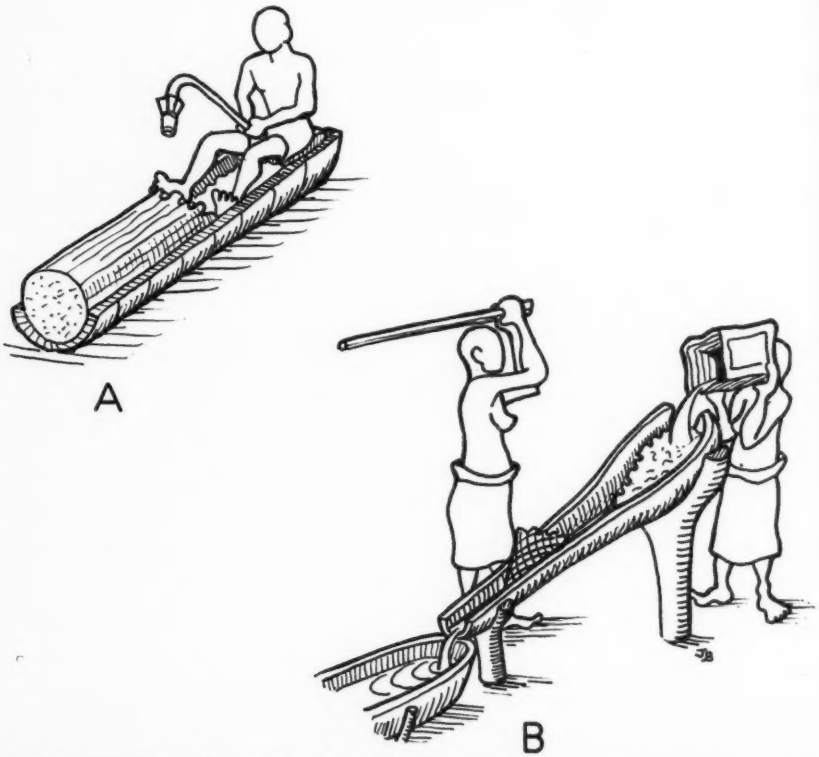
It is scarcely possible to increase the food value of sago; supplementing of the diet seems to be reasonably assured by the natural resources. The living con-

ditions of the swamp forest peoples of New Guinea could be improved by an industrialization and marketing of sago, as a source of revenue in these poverty-stricken areas.

The huge *Metroxylon* forests of New Guinea represent enormous potential resources in starch for export and industrial uses and deserve new research ranging from a botanical survey of the species and varieties to a study of the processing methods.

References

1. Barrau, J. Subsistence Agriculture in Melanesia. Bernice P. Bishop Museum. Honolulu, 1958.
2. Beccari, O. Asiatic Palms, Lepidocaryeae. Ann. Roy. Bot. Gard. Calcutta 12, 2, 1918.
3. Jumelle, H. Cultures Coloniales, Plantes a Fécule et Céréales. Paris. 1925.
4. Kanehira, R. Flora Micronesica. Tokyo. 1933.
5. Glassman, S. Flora of Ponape, Bernice P. Bishop Museum. Honolulu. 1952.
6. Burkill, I. H. A Dictionary of Eco-



30. Sago processing in New Guinea: (A) crushing the stipes' pith; (B) extracting the starch from the crushed pith. Drawings by the author.

nomic Products of the Malay Peninsula. London. 1935.
7. Bennett, G. Gatherings of a Naturalist in Australasia. London. 1840.
8. Guppy, H. B. Observations of a Naturalist in the Pacific between 1896 and 1899. London. 1906.
9. Massal, E. & Barrau, J. Food Plants of the South Sea Islands. South Pacific Commission. Nouméa. 1956.

The Editor's Corner

Continued from page 39

them furnished information condensed by the editor. The flavor of Dr. Bondar's adventures cannot be caught in a brief sketch. Those who read Portuguese will find the autobiographical account in *Revista de Entomologia* for 1943 a stirring story.

The germination of palms is a subject fascinating to any grower. Dr. Tomlinson, who has written an earlier paper in PRINCIPES (vol. 1: 163-173. 1957), begins here a series of articles explaining something of the structure of palms. Following articles will discuss the structure of seedling leaves, stems, leaves, and other parts of palms.

Some members deplore the paucity of information on culture of palms in PRINCIPES. The editor regrets that this is due to a lack of proved information and articles. We attempt to achieve a balance of interest and will welcome contributions on the subject of culture.

The Cuban Belly Palm-Colpothrinax Wrightii

HAROLD E. MOORE, JR.

Cuba's belly palm (*Colpothrinax Wrightii*) is mentioned in this issue of PRINCIPES as a challenge to growers (page 66). It has not yet been successfully cultivated in South Florida and doubtfully elsewhere. The photographs provided by Nixon Smiley (cover) and Frank Gatteri (figs. 31-32) demonstrate the unusual swollen trunk of this palm which has caused it to be called belly palm, bottle palm, or *palma barrigona*. The species is unique in other less conspicuous characteristics. The trunk, however, is very striking. Brother Marie-Victorin has given his impression on first seeing this palm near Concepción del Sur, Pinar del Rió, in the delightful "Itinéraires Botaniques dans l'Isle de Cuba" [*Contributions de l'Institut Botanique de l'Université de Montréal* 41: 132. 1942] written by him and Brother Léon and here translated freely.

"The sun was touching the horizon. Suddenly Brother Léon touched my arm: 'Look! *Colpothrinax Wrightii!*' And I saw a strange palm, which one does not forget when one has seen it in its environment. An amateur palmologist, Captain Johnston, when he passed by there with Brother Léon, burst out laughing when he saw the big-bellied palm for the first time, for it is a name that it merits and bears, belly palm, *palma barrigona*."

Colpothrinax grows on the sandy plains of western Pinar del Río and on the Isle of Pines, Cuba, where it forms extensive open stands, often with pines. Even when the land is cultivated for tobacco, the palms are often left standing, exposing their obesity. The bellies of these palms are used to make casks, beehives, water troughs, and sometimes boats or canoes. The trunks are used for small buildings, the leaves for thatch, and the fruit for hog feed.

31. A handsome grove of *Colpothrinax Wrightii* on Isle of Pines, Cuba. Photograph by F. Gatteri.

A botanical discussion of *Colpothrinax* has been provided by Dr. L. H. Bailey in *Gentes Herbarum* 4: 356-360, 1940. There additional illustrations may be seen. Still others accompany Brother Léon's text for the palms in *Flora de Cuba* 1: 258-259, 1946, and more appear in the first two volumes of the aforementioned "Itinéraires Botaniques dans l'Isle de Cuba." There is only one species in the genus which at one time was thought sufficiently close to *Pritchardia* of the Hawaiian Islands, the Dangerous Archipelago, and the Fiji Islands, to be included in that genus. Dr. Bailey's study, however, emphasized a number of important differences sufficient to separate the two genera.

Botanically, the belly palm is a member of the subfamily Coryphoideae related to *Pritchardia* and perhaps to *Washingtonia*. The swollen self-cleaning trunk is unarmed, reaching a height of 30 feet, and bears a crown of large costapalmate leaves with long petioles and fibrous sheaths. Large branched in-

32. Trunks of belly palm used for support. Isle of Pines, Cuba. Photograph by F. Gatteri.

florescences appear among the leaves, each branch and the base of the main axis subtended by tubular bracts. The bisexual flowers have a cuplike calyx of united sepals and a corolla of three persistent petals, thus differing from *Pritchardia* in which the petals soon fall away. The six stamens are united by the bases of their filaments but do not form an evident exserted collar and the three carpels are united only by their styles. One of the carpels usually develops into a brown rounded fruit measuring about 9/16 inch in diameter. The seed has homogeneous endosperm.

There has been some question concerning the first valid appearance of the name for this species. A brief but apparently adequate description was given by Siebert and Voss in *Vilmorin's Blumengartnerei* 1: 1147, 1895, with the epithet misspelled and a reference to an unpublished name. Thus the complete citation for the name of the belly palm is *Colpothrinax Wrightii* Grisebach & H. Wendland ex Siebert & Voss.

Essays on the Morphology of Palms

P. B. TOMLINSON

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I. GERMINATION AND THE SEEDLING

Because palm seeds have been most easily available to botanists of temperate countries the development of their seedlings is much more fully understood than is the construction of mature palms. Gatin (1, 2) is the chief authority on the subject.

Palms have a single seed leaf or cotyledon. When the palm seed germinates and its minute embryo grows, the cotyledon never expands a green, assimilating blade but remains partly or wholly underground. This type of germination is called hypogeal. Even though much modified, parts of the cotyledon corresponding to the blade, petiole and cylindrical sheath of a normal leaf can often be recognized.

The apex of the cotyledon, corresponding to the leaf blade, remains embedded in the endosperm or food reserve of the seed. It functions as a suctional organ or haustorium and since it continues to grow, often to a great size, as the seedling develops it is an object of great interest. In the cocoid and some borassoid palms, where the endosperm is hollow, the sucker eventually fills the central cavity. In the coconut itself the haustorium may become as big as a man's fist. In those palm seeds in which the endosperm is ruminate or otherwise folded, the sucker eventually replaces the endosperm and so adopts its irregular shape. The surface layers of the haustorium secrete enzymes which convert the inert materials of the endosperm into soluble substances which pass through the cotyledon and so nourish the seedling until it is capable of independent growth.

According to the amount of extension of the different parts of the cotyledon, several types of germination can be recognised in palms. *Phoenix* is the best known example of the first type (fig. 33Aa-c). The sucker (h.) enlarges until it occupies the space within the seed formerly filled by endosperm. When dissected from the seed it resembles a narrowly peltate leaf. The cotyledonary petiole (p.), but more particularly the sheath (sh.), elongates until the cotyledon is several centimetres long. As a result the undeveloped plantlet is carried well below the soil surface. Eventually the first leaves of the seedling grow out through a long, narrow oblique cleft representing the mouth of the sheath. This cleft is present in the embryo. It enlarges as the sheath elongates but only becomes obvious when the plumule (pl.) is exserted. The appearance of the plumule is preceded by that of the radicle (r.), or first root. The rudiments of this first root are present in the embryo, ensheathed by cotyledonary tissues. As it grows, it bursts through the base of the cotyledon and so resembles a prolongation of the cotyledonary organ. The radicle persists for only a limited period, then, as in all monocotyledons, since it is incapable of growth in thickness, it is replaced by adventitious roots originating at the base of the developing stem. The first plumular leaf (I.) consists of a protective sheath alone, without a green

blade. Its apex is pointed and rigid and is very effective in penetrating to the soil surface. Subsequent leaves, at first enveloped by this sheath, eventually expand their green blades above the soil surface (II.).

Apart from *Phoenix*, this type of germination is characteristic of the fan palms of the coryphoid and borassoid groups, together with feather-palms of the caryotoid alliance and certain members of the cocoid group.

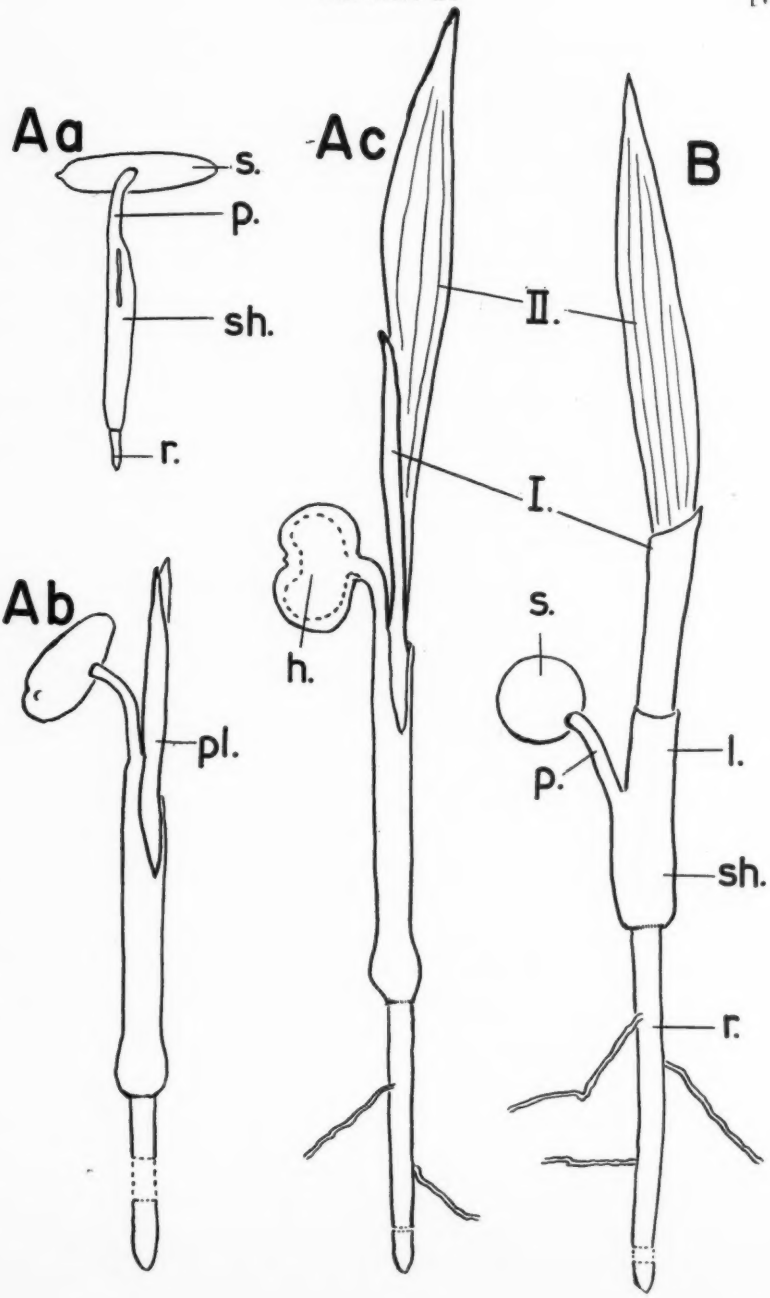
A second type of germination closely resembles that described above, except that an additional organ, the ligule (l.), is developed (fig. B). This is a tubular structure produced by proliferation of cells around the mouth of the cotyledonary sheath. It is present in certain coryphoid palms, such as *Livistona*, *Sabal* and *Washingtonia*, together with some cocoid palms, as *Jubaea*. A tubular ligule, on the other hand, is not characteristic of adult palm leaves except in many scandent genera in which the leaf sheath itself is long, narrow and cylindrical. In some small palms, e.g. *Bactris*, a ligule is only seen in undeveloped leaves and becomes disorganized as the leaf matures. Most palms with a ligulate cotyledon do not have a ligule on subsequent leaves.

The above methods of germination, in which the tender plantlet is buried well below the soil surface, may be of adaptive significance in palms of dry situations. Many palms of arid regions undoubtedly derive benefits from long cotyledonary organs. In *Borassus* and *Hyphaene*, for example, the fleshy cotyledon may be up to two feet long and it is often eaten as a succulent vegetable by the natives of India and parts of Africa. On the other hand, the way in which the radicle first develops does not suggest a moisture-seeking function. Except in *Trachycarpus*, it never develops absorptive root hairs and branch roots are few.

The cotyledonary organ of the double coconut, *Lodoicea maldivica*, is most peculiar. Instead of growing vertically it grows horizontally for a distance of many feet and forms a thick cord connecting the seedling to the remote seed (3).

A third type of germination occurs in the remaining palms. This has been described in detail in *Archontophoenix* (fig. Ca-c) by Gatin. In this type the cotyledon scarcely elongates and the seedling develops adjacent to the seed. The embryo is curved and as the cotyledon grows the plantlet is extruded from the seed in a button (b.) of tissue. Parts of the cotyledon corresponding to a petiole and sheath are not obvious, but a sucker (h.), representing the cotyledonary blade, remains embedded in the seed. However, a prominent ligule (l.) is always developed at right angles to the cotyledonary axis. It is a cylindrical outgrowth from the margins of the cleft which represents the open end of a sheath. The plumule (pl.) eventually protrudes through this ligule. Because the embryo is curved, the radicle grows out at an oblique angle to the plumule. This first root (r.) is narrow and of restricted growth and is soon replaced by a wide lateral root (r.′) which extends in the long axis of the plumule and so plays the role of principal root. Eventually, however, this also is replaced by lateral roots from the young stem. The plumule develops two bladeless sheaths (I., II.) before a leaf with a green blade appears (III.).

In this type of germination, in which a ligule is always developed, there is much less variation between different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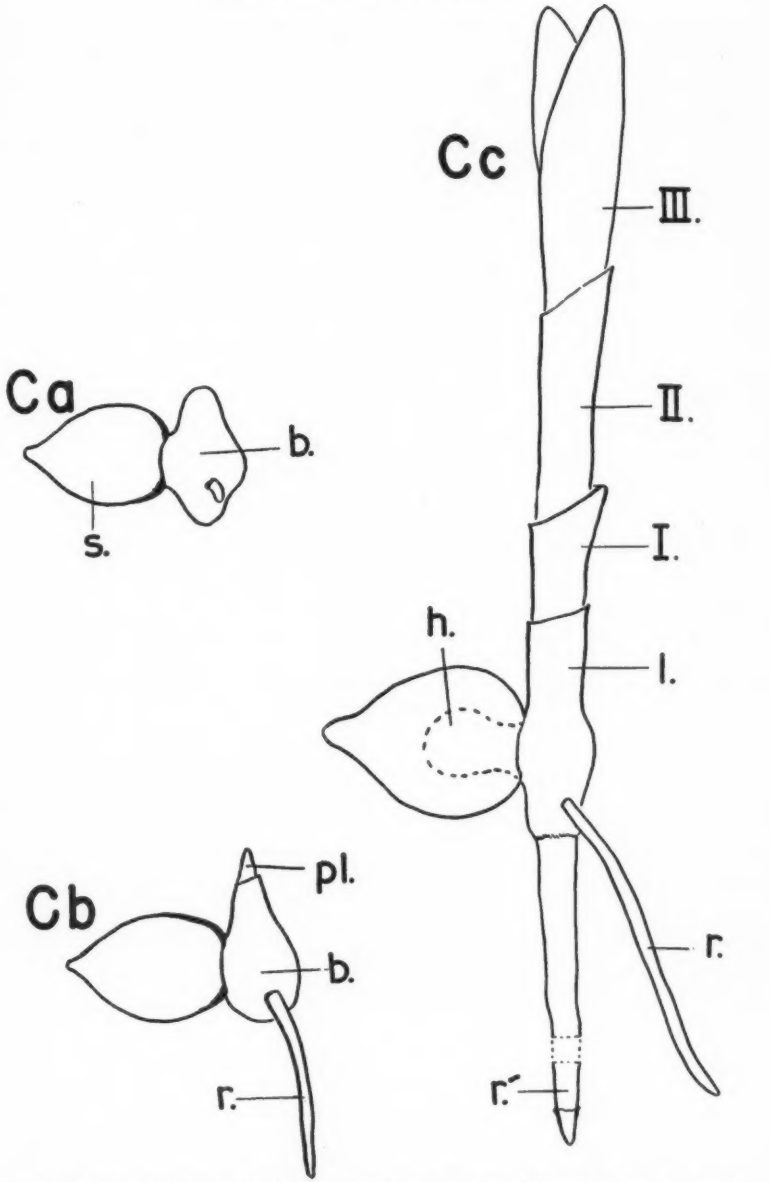
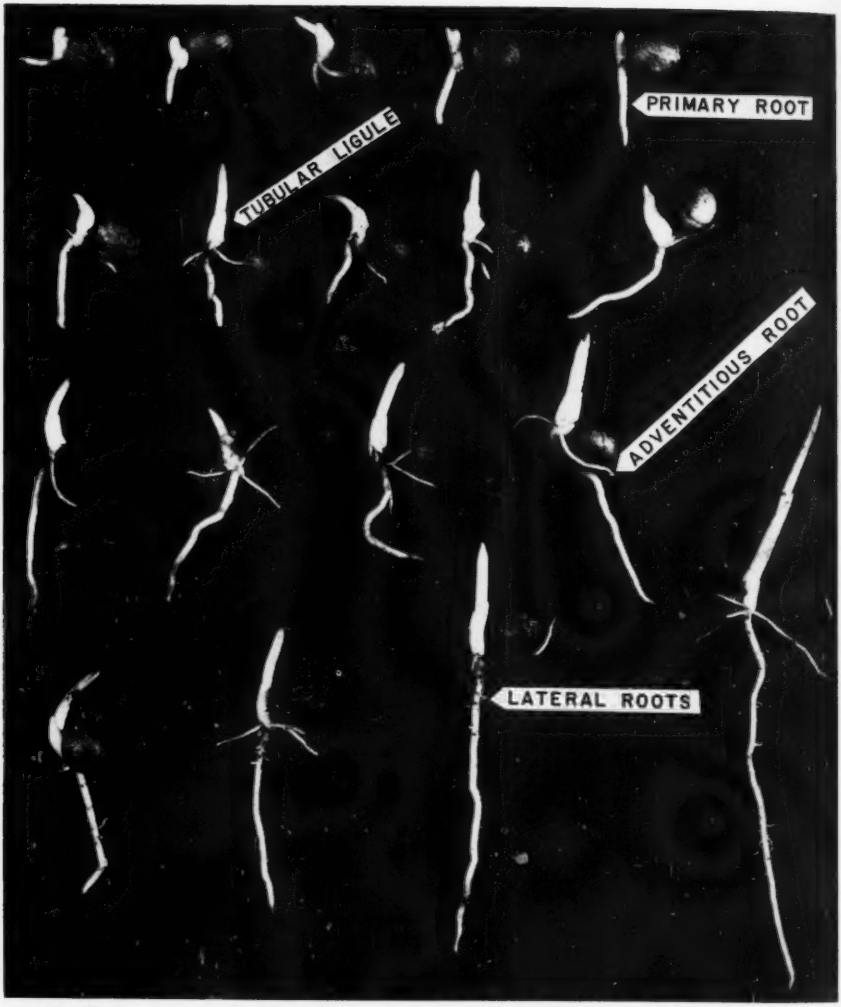


33. A, *Phoenix dactylifera* (×1); a-c, seedling at three successive stages of growth. B, *Washingtonia filifera* (×1), seedling. C, *Archontophoenix Cunninghamiana* (×1½); a-c, seedling at three successive stages of growth. b.-"button"; h.-haustorium; l.-ligule; p.-petiole; pl.-plumule; r.-radicle; r'.-first adventitious root; s.-seed; sh.-cotyledonary sheath; I.-III.-plumular leaves of successive stages.



34. Early stages in the germination of royal palm seeds *(Roystonea)*. A primary root develops first (top row) followed by two to five whorled adventitious roots (2nd and 3rd rows). Lateral roots then appear on the latter (4th row). Photograph and notes by Jean L. Smith, Department of Botany, University of Florida, Gainesville, Florida.

species than in the first two types. Seedlings of this *Archontophoenix*-type probably are natural occupants of shaded and moist situations where burial of the seedling by an elongated cotyledon is of no ecological advantage.

In distinguishing these three types of germination Gatin showed that each was correlated with a particular type of embryo. In the *Phoenix*-type the embryo

is straight and the plumule and radicle lie in its axis. In the *Archontophoenix*-type the whole embryo is curved, whilst in the *Washingtonia*-type, although the embryo is straight, the plumule and radicle are situated obliquely to its long axis.

A fourth type of germination in palms has been suggested for *Nypa* and *Phytelephas* in which it is said that it is the radicle which forms the suctorial organ. Reports are conflicting and observations need confirming. Gatin (1) indicates that *Phytelephas* is not different from *Phoenix*.

Literature Cited

1. Gatin, C. L. 1906. Recherches Anatomiques et Chimiques sur la Germination des Palmiers. *Annales des Sciences Naturelles (Botanique)* ser. 9, 3: 191-314.
2. ———— 1912. *Les Palmiers*. Paris.
3. Thiselton-Dyer, W. T. 1910. Germination of the Double Coco-nut. *Annals of Botany, London* 24: 223-230.

Gregório Gregorievich Bondar, 1881 - 1959

Some people are privileged to know palms intimately. Such a person was Dr. Gregório Bondar of Brazil who died in February 1959 leaving us a legacy of his published papers on palms of Brazil written from first-hand knowledge of them. The following account of his life is abbreviated from a fuller autobiographical sketch in Portuguese to be found in *Revista de Entomologia* 14: 313-319, 1943, augmented by information provided by Dr. Bondar's daughter, Dona Jacy Bondar Nogueira and Dr. Klare S. Markley. Dona Jacy is a botanist in her own right, translator of the above account, and author of *Glossário de Palmeiras Oleaginosas e Ceríferas* and *Glossario de Plantas Oleaginosas e Ceríferas. II. Euforbiaceas*. Dr. Markley is a horticulture specialist with the United States Operations Mission to Brazil and was associated with Dr. Bondar in his work.

Gregório Gregorievich Bondar was born on November 18, 1881, in the village of Malaia, Buromca, district of Zolotonocha, Department of Poltava, Russia. There he attended primary school until 1892. His family emigrated in 1894 to the Department of Jenisseisk in the center of Siberia where Dr. Bondar farmed and served as a notary in several places before entering the Seminary of Kransnojarsk from which he graduated in June, 1902. For three years thereafter he taught in primary schools in Siberia until events of the Russo-Japanese war and the following political upheaval forced him to leave Russia for Manchuria where he remained until 1908 under another name.

In June, 1908, Dr. Bondar moved to France where he attended the Agricultural Institute of Nancy University under his own name, graduating as an agronomist in 1910. A fugitive still from political charges in Russia, he went to Brazil in that same year and was naturalized in 1913. During the years from 1910 to the end of 1915, he worked at the Instituto Agronomico de Campinas and taught at the Escola Superior de Agricultura de Piracicaba as a professor of farm zoology and entomology.

Early in 1916, Dr. Bondar returned to Russia and joined the armed forces. Near the end of the year he was arrested for his political crime of 1905, sent to Siberia in January, 1917, and then freed after the revolution of February 17, 1917. Thereafter he held political and

scientific offices in Siberia until again arrested and condemned to death on December 24, 1919. The sentence was not carried out nor was a later one, and eventually he escaped to Japan by way of Mongolia, Manchuria, and Korea. From Japan, Dr. Bondar returned to Brazil where, from 1921 until 1932, he worked as an entomologist and phytopathologist for the state of Bahia. After experience as chief of the Agriculture Technical Department and director of the Experiment Station at Agua Preta in the Cacao Institute of Bahia, he went to the Instituto Central de Fomento da Bahia in 1938 as a technical consultant.

Dr. Bondar retired from the Agricultural Secretariat in 1951. In 1933, he was awarded the sum of 100,000.00 cruzeiros by the National Congress for his "experimental studies of native economic plants, especially gummiferous plants, technically advancing the preparation and growing of new products for export, and for his outstanding botanical and entomological studies and discoveries carried out in this country which have attained an international scope." From 1956 until the time of his death, Dr. Bondar was a part-time consultant with the Escritório Técnico de Agricultura Brasil-Estados Unidos and in 1957 resumed activities with the Ministério da Agricultura in Bahia. With the former agency, he carried out independently or together with Dr. Klare S. Markley, a survey of the distribution of the babaçu palm *(Orbignya speciosa)* in practically all areas of Brazil in which this palm had been reported to occur. It was while returning from Mato Grosso and the Territory of Rondonia where he and Dr. Markley had been studying the distribution of this palm that Dr. Bondar suffered a cerebral hemorrhage and died in a São Paulo Hospital on February 20, 1959.

Many of Dr. Bondar's numerous publications concerned insects, agriculture, or economic botany. Others were of ethnographical nature, dealing with Siberia. Those which dealt with the palms are listed below. His collection of insects, part of which is now at the American Museum of Natural History in New York, was extensive. He was elected a member of the Russian Entomological Society in Petrograd (now Leningrad) in 1916 and of the Centro de Ciências, Letras e Artes de Campinas, São Paulo, in 1911. He was also a member of the Sociedade de Entomologia de Argentina and research associate in insects at the Chicago Natural History Museum.

These notes can give but a brief review of an exciting and productive life which is well summed up by Dr. Markley: "In Dr. Bondar's death, the world and especially Brazil, lost an outstanding natural scientist; one of that dwindling group of men who have made many contributions to mankind under exceedingly trying and difficult circumstances; men to whom physical discomfort and even extreme hardship, hazards of health and risk of life, and lack of adequate monetary reward meant little and scientific achievement meant everything."

Publications Relating to Palms

1. A Exploração da Piassava no Estado da Bahia (Exploration for Piassava in the State of Bahia), Bahia, 1926.
2. O Licuriseiro (The Licuri Palm—*Cocos coronata*), *Instituto Central de Fomento Economico da Bahia, Boletim* 2: 1-18. 1938.
3. Palmeiras na Bahia do Genero Cocos. (Palms of the Genus Cocos in Bahia) *op. cit.* 4: 1-19. 1939.
4. Importancia Economica das Pal-

meiras Nativas do Genero Cocos nas Zonas Seccas do Interior Bahiano (Economic Importance of Native Palms of the Genus Cocos in the Dry Regions of Interior Bahia). *op. cit.* 5: 1-16. 1939.

5. Palmeiras da Bahia (Palms of Bahia). *op. cit.* 6: 1-22. 1939.

6. O Coqueiro no Brasil (The Coconut in Brasil). *op. cit.* 7: 1-100. 1939.

7. Insetos Nocivos e Molestias do Coqueiro no Brasil (Injurious Insects and Diseases of the Coconut Palm in Brasil). *op. cit.* 8: 1-160. 1940.

8. Palmeiras do Genero Cocos e Descrição de Duas Especies Novas (Palms of the Genus *Cocos* and Description of Two New Species). *op. cit.* 9: 1-53. 1941.

9. As Cêras no Brasil e o Licuri *Cocos coronata* na Bahia (Waxes of Brasil and the Licuri *Cocos coronata* in Bahia). *op. cit.* 11: 1-86. 1942.

10. A Piassaveira e Outras Palmeiras Attaleaineas na Bahia (The Piassava Palm and other Attaleinae in Bahia). *op. cit.* 13: 1-73. 1942.

11. Palmeiras Nativas (Gênero *Côcos*) na Alimentação dos Animais Domesticos (Native Palms (Genus *Cocos)* as Animal Feed). *Instituto de Pecuária da Baia, Publicação* 6: 1-24. 1939.

12. New Palms of Bahia. *Field Museum of Natural History, Botanical Series* 22: 455-463. 1942.

13. Palmito e o Côco nos Usos Culinários no Brasil (Hearts of Palm and Coconut in Brazilian Cooking). *Boletim do Ministério da Agricultura* 31: 1-23. 1942.

14. Retificação Sobre Algumas Palmeiras do Brasil (Corrections Concerning Some Palms of Brasil). *Rodriguesia* 27: 189-190. 1952.

15. Nova Espécie de Orbignya, Produtora do Óleo de Babaçú (A New Species of Orbignya, Producer of Babaçú Oil). *Arquivos do Jardim Botanico* 13: 57-59. 1953.

16. *A Cultura do Coqueiro (Cocos nucifera) no Brasil* (The Cultivation of Coconut in Brasil). 74 pp. Bahia. 1955.

17. O Dendezeiro (African Oil Palm). São Paulo. 1956.

18. Novo Gênero e Nova Espécie de Palmeiras da Tribo Attaleini (A New Genus and Species of Palm of the Tribe Attaleinae). *Arquivos do Jardim Botanico* 15: 49-55. 1957.

PALM LITERATURE

Bondar, G. Novo Gênero e Nova Espécie de Palmeiras da Tribo Attaleini. *Arquivos do Jardim Botanico do Rio de Janeiro* 15: 49-55. 1957.

This last article by Dr. Bondar describes a new genus, *Markleya*, named in honor of Dr. Klare S. Markley who has been studying economic aspects of palms in South America. The epithet of the single species, *Markleya Dahlgreniana*, honors Dr. B. E. Dahlgren, author of *Index of American Palms*. *Markleya* is closely related to *Orbignya* and is thought possibly to represent a hybrid between *Maximiliana Martiana* (*M. regia*) and *Orbignya speciosa*. Both the latter grow with the newly described palm in the Municipio of Bragança, State of Pará, Brazil. Latin and Portuguese descriptions are provided and photographs illustrate staminate flowers and fruits.

H. E. Moore, Jr.

IN AND OUT OF THE PALM GARDEN

When the garden club comes over to inspect your palms, that question is going to pop up once again, asked with an urgency that amounts almost to anxiety, about what and when to feed the palms. You have to cover the whole subject in one or two brief sentences, for certainly not all fifty of the ladies are going to stand still for the mosquitoes while you deliver a half-hour lecture. Tell them it can't be repeated too often that, if a palm is planted right to begin with, the question of what to feed it is not too acute; dress the root area once a year with cow manure, if the gardener owns a dairy farm, or three times a year feed milorganite in crowbar holes if the gardener is an athlete with a good bank account. If not a dairy farmer and not an athlete, then spread a moderate amount of 4-7-5 or 6-6-6 twice a year and let it go at that. This is all you have time to say, but you know perfectly well that the requirements of all palms are not the same and moreover that the same kind of palm may need different treatment from one locality to another. One way adequately to answer questions would be to prepare a printed pamphlet, or better yet an illustrated book of about 300 pages, and hand it out to questioners. Even the dentist, after all, hands out a free brochure on the "Care of False Teeth" to every patient who is suddenly no longer in any position to enjoy a toothache. This saves the dentist's time, and to have a proper monograph on the "Care and Feeding of Palms" would save yours too.

* * *

The preceding paragraph hints, and not darkly, at the well-known fact that we still have no book on the cultivation of palms. One reason, doubtless, is the lack of a broad market. A better reason is that palm cultivation cannot be standardized. One gardener's climate, soil, pests, diseases and set of purely local problems are, like fingerprints, not an exact duplication of someone else's. Zeke Jimpson has to water his palms incessantly on his high, sandy land, whereas H. Kenilworth Buckram-Jones keeps himself insolvent by trying to pump the floods off his lowland palms just two miles distant from Zeke's place. And those are fifty reasons why we have no book, pretentious or otherwise, on the cultivation of palms.

* * *

Many of the larger palms in warmer regions harbor hordes of insects without apparent detriment to the plants. Aside from pests the commoner palm-dwellers in Florida are several species of ants not responsible for aphids and scale insects, millipedes and numerous other forms of life not so readily noticed, plus the abundant palmetto bugs which are just as partial to certain other palms as to the palmettoes. "Palmetto bug," like "Florida lobster" for crawfish, is only a euphemism for a species of husky cockroach, according to cynical visitors. When the royal palm leaves fall away, several bewildered palmetto-bugs almost invariably are exposed behind the sheathing bases. Larger creatures too live in some of the palms, at least transiently, as nesting birds and tree rats. In late summer and fall, when the palmettoes are loaded with ripening fruit, rats have been known to remain in the crowns without once descending for six weeks or longer, until the food supply is exhausted. Tales of snakes living in palms are prevalent enough, but have to be scrutinized because of the kinship of snake stories to fish stories. One such tale deals with a coral snake living in

the crown of a tall queen palm that had blown down in a high wind. The twenty-inch snake crawled out of the crown, sure enough, but it must have crawled in after the tree had fallen; it was not equipped with legs and so could not have climbed twenty-five feet of smooth trunk. Palms have no monopoly on visiting snakes, and probably are not invaded as often as other trees.

* * *

Snakes ascend trees in search of food, and not just for the view. Besides, herpetologists rank them only fourth-rate as connoisseurs of the landscaping and assert that they care very little about how much it may have cost.

* * *

A true snake story told by a palm enthusiast begins in a sawdust pile at an abandoned millsite in the pine woods. He brought in a load of the sawdust which was used as a mulch about small palms, and shortly a batch of young rattlesnakes "hatched" out. The baby rattlers, finding it pleasant to loll about in the baby palms, were promptly observed and were so very unwelcome in the garden that all sawdust was thereafter denied the premises.

* * *

The famous chapter on snakes in Bishop Pontepiddan's book about Iceland contains but one short sentence to this effect: "There are no snakes in Iceland." Equally arresting, and just as revealing, is a single sentence in a letter received from Walter Hodge, distinguished President of The Palm Society, under date of August 27, 1959. Dr. Hodge remarks that, "Having just returned from the Canadian Arctic on a field trip associated with the IX International Botanical Congress, I can tell you that there are no palms in the flora."

Mohammed Drar writes of the necessity of driving snakes from the crowns of date palms in certain Egyptian localities where the dates are unprotected from raiding birds. "Birds are troublesome during the ripening season also in certain desert areas where groups of a limited number of palms are grown. In such localities snakes may climb the trees in order to attack the nests of young birds or to feed on birds which happen to visit the trees. Whenever the writer visited Ey 'Amriya gardens of the Mariut district in September, he observed a guard firing his gun on the crown of the palms suspected to be harboring snakes." (Tackholm and Drar, *Flora of Egypt*. 2: 184. 1950).

* * *

Snakes both long and short may be laid aside in favor of more toothsome matter, of which M. Drar chiefly treats. He states that the date palm pollinated by any other variety will yield its perfect fruit. Not a surprising circumstance unless species as well as variety was meant to be implied. This may have been the intention, for he goes on to cite an example of a date palm setting standard fruit when the pollen had come from *Phoenix reclinata*. This would cause the non-date people, naturally ignorant in such matters, to indulge in a certain amount of speculative wonder. Is it possible that the pollen from most or all of the *Phoenix* species will fertilize the pistillate flowers of *P. dactylifera* and good fruit result in a proper date-growing environment? If so, would the dates be true not only to the species of the female parent but to its variety also? No doubt the specialists in date culture know a great deal about this subject, which in this case concerns the fruit but not the seed.

The palm fancier usually knows little about date gardens or about dates as fruits. If, however, he grows in his garden several species of *Phoenix* he knows that, no matter what the fruits look like, the seed when viable will produce a hybrid plant if it derives from an interspecific union. He also knows that seeds of the quality dates engendered by pollen from *Phoenix reclinata* are not at all apt to produce palms that, in their turn, will one day produce dates of equivalent quality; and that, on the contrary, the fruits may not be classified as dates at all. He has observed, too, that if his ornamental *Phoenix* palms of several different species are all female trees, usually all bear fruit despite the absence from his collection of trees with staminate flowers. His palms, he is obliged to conclude, are cross-pollinated by insects or the wind by the pollen from one or more *Phoenix* species represented in the general neighborhood.

* * *

It is impossible to determine the ancestry of natural hybrids in *Phoenix* when neither parent is known. One may suspect specific likenesses or make what seems a reasonable guess, but however plausible the guess it must remain forever in the shady realm of conjecture. Nonetheless there are necromancers cocksure and glib enough to dispel all mysteries concerning natural hybrids in *Phoenix*.

* * *

Among other dioecious palms common in cultivation, problems of crossing are, if not exactly minor, far fewer than in *Phoenix*. The cultivated palms of other genera have no comparable tendency to hybridize so freely. Moreover, fewer species of other dioecious genera commonly are cultivated in the same garden, unless it be of *Chamaedorea*. Natural hybrids of the latter, or plants believed to be such, have been observed in the wild and presumably crossing of the species would not be an impossibility in the garden. Certainly, however, hybridization is not universal or common in the palm family, nor is it artificially induced by growers as with the plants of many other families. Natural crossing is suspected perhaps oftener than it actually occurs, but it cannot be gainsaid that it does sometimes occur in many kinds of palms, including of course those that are monoecious. Full and authoritative information concerning palm hybrids is either lacking or meager, apart from any knowledge gained from the "plant breeding" of such economic palms as the date. Unfortunately studies of uncontrolled hybridization would be essentially theoretical, for they would be based on probability and assumption instead of fact. Analyses of human blood have been introduced in court as evidence of parentage, but have been held not to constitute proof, whence it seems unlikely that lowlier forms of life could furnish better biologic evidence.

* * *

The Puzzle of the Month Club has just come out with its latest conundrum, to wit, Why is it that attempts to grow in Florida the strange Cuban "belly palm," *Colpothrinax Wrightii*, so far have met with uniform failure? Anyone answering this query to the satisfaction of the judges will receive thirty gallons of palm wine contained in a cask fashioned from the ventricose section of the subject palm. Second prize will be Heart of Palm (one tin), being the bud of a cabbage tree grown in Florida, shipped to Jersey City for canning and trans-shipped back to Florida for the hotel trade at Miami Beach.

WHAT'S IN A NAME?

Acrocomia (ak ro kó mee a) is derived from the Greek words *akros* (highest, at the farthest point or extreme) plus *kome* (hair or tuft), which combination suggests the stately crown of pinnate leaves born at the summit of the columnar trunk so characteristic of this genus of palms.

Calamus (kál a mus), the largest genus of palms, is made up mostly of climbers, all native in the Old World tropics and subtropics. The light, tough, reed-like stems clamber into the tallest trees by means of special adaptations in the form of hooked spines. Some of the species yield rattan. The generic name is the Latin word *calamus* (reed, cane) which was derived from the Greek *kalamos* (reed).

Chamaerops (ka mée rawps) is a genus of palms whose members are commonly humble and shrub-like in habit of growth. The technical name is a compound of the Greek words *chamai* (low, on the ground) and *rhops* (a bush or shrub).

Cocos (kó kos), a monotypic genus as now understood, includes only the coconut palm, *Cocos nucifera*. The generic name was established by Linnaeus as a feminine singular noun, though the term is derived from the Portuguese and Spanish masculine substantive *coco* (coconut palm). *Coco* is a modern Romance language form of Latin *coccum* (berry, kernel), which in its turn evolved from the Greek word *kokkos* (berry, seed). The final *s* of *Cocos* reflects the original Greek termination; it is a Hellenization which effects correspondence with other Greek generic names ending in *-os;* for example: *Diospyros, Strychnos, Symplocos, et al.*

Corypha (ko ryé fa) is a genus of massive fan palms especially noteworthy for the spectacular inflorescence which towers well above the crown. This flowering and fruiting occurs only once, after which the palm dies. The technical name is derived from the Greek *koryphe* (summit, peak), thereby denoting the area of this unique feature.

Mascarena (mask a rée na) is a genus created by L. H. Bailey for three species of palms, two of which (*M. lagenicaulis*, the bottle palm and *M. Verschaffeltii*, the spindle palm) are rather widely cultivated in tropic lands. The generic name is a neo-Latin formation after the Mascarene Islands in the Indian Ocean, the native habitat of these palms.

Pelagodoxa (pel ago dóck sa), a small genus of palms found growing in dense shade in their native haunts near waterfalls and streams which provide them with a high humidity. One species (*P. Henryana*) is native to several volcanic islands of the Marquesas group, and another (*P. mesocarpa*) is believed to be indigenous to the Philippine Islands. The generic name is a combination of the Greek words *pelagos* (the sea) and *doxa* (praise, glory). The Latin form *pelagus*, derived from the original Greek term, not only denoted the sea but also came to designate any swift stream or torrent of water. This semantic shift is of importance to our understanding of these palms, for those that have been under cultivation near the sea have not survived.

Opsiandra (op si án dra), is composed of the Greek words *opsis* (sight, appearance) and *aner, andra* (man, male), suggesting the fact that the male flowers persist for months on the inflorescence after the female flowers have already developed into fruits. Those generic names terminating in *-andra,* despite their masculine derivation, are treated as

feminine in their Latinized form; hence adjectives modifying such generic names carry the Latin feminine ending: *Ptychandra glauca*. As now defined, the genus *Opsiandra* comprises but one species, the *Opsiandra Maya*. The specific epithet *Maya* is not an adjective in this case, but a proper noun (hence capitalized) which stands in apposition to the generic term.

Rhapidophyllum (rap i do fill um) is a monotypic genus established in 1876 by H. Wendland and O. Drude for *Rhapidophyllum hystrix*, a species which ranges from South Carolina to central Florida and westward into Alabama. The so-called needle palm, blue palmetto, creeping palmetto, or vegetable porcupine was first discovered growing near Savannah, Georgia by John Fraser and was given the name *Chamaerops hystrix* by Frederick Pursh. Subsequently it was shunted to *Sabal*, *Corypha*, and *Rhapis*. The current generic term is a compound of the Greek words *rhapidos* (a rod) and *phyllon* (leaf) in allusion to the numerous long, slender, needle-like structures in the leaf-sheath. The specific epithet *hystrix* is the Greek word for hedgehog — lest we should forget that this humble fan palm is formidably armed. In botanical literature one occasionally finds the word written with an initial capital: *Hystrix*. Inasmuch as the name is not a proper noun honoring an individual, nor does it commemorate a former generic name, there is no valid reason for this capitalization.

Zombia (záhm bee a) is a generic name established by L. H. Bailey. It is a vernacular name for which Dr. Bailey held no affection, but evocative it is with its overtones of black magic and Haitian voodoo sorcery. A zombi has been defined as a dead body, soulless but able to walk, act, and move about as if it were alive. The single species comprising the genus (*Zombia antillarum*) is a dwarfish fan palm which forms a clump and one or several stems to a height of ten feet. These trunks are covered over with a loose sleeve of open-woven structure and beset with rows of formidable spines. The palm, found growing on high slopes in very hot, dry areas, is known to the Haitians as *latanier zombi*, the word *latanier* being employed to denote any fan-leaved palm. One has only to fancy this palm in the barren setting of its natural habitat with a bright moon playing on its features to comprehend something of the eerie phantasmagoria that could pass in the minds of those who know little of our scientific age and its no-nonsense attitudes.

BRUCE H. BEELER

News of the Society

Continued from page 39

Slide Collection

The Society's slide collection is now ready to travel to local groups for showing at their meetings. The rules are simple: ask for slides well in advance of your meeting date, so they may be reserved for you at that time; send a deposit of $10.00, which will be returned when the slides are sent back to headquarters; send them back immediately after the showing, as others may be waiting for them. A brief commentary goes with the slides. Suggestions for improvement are welcomed, and new, better slides are received with gratitude.

Palm Seeds

The Seed Bank has been greatly helped in distributing seeds by the staffs of Fairchild Tropical Garden and of the Alvin R. Jennings estate. These two palm collections contain hundreds of mature palms, many of them producing

seeds. Mr. Ray Vernon and Mr. Adolph Jordahn of the Jennings estate have for years been gathering the palm fruits and delivering them to Fairchild Garden, where they are added to those obtained from trees grown at the Garden under the care of its director, Mr. Nixon Smiley, and superintendent, Mr. Stanley Kiem. There the tedious work of cleaning the seeds is done before they are sent to correspondents in many parts of the world. Some of them are passed on to Mr. De Leon for The Palm Society Seed Bank.

We are grateful to Mrs. Alvin R. Jennings and all the above-mentioned gentlemen for their help.

LUCITA H. WAIT

California News

For those planning to travel in Mexico, the California group is preparing a list of species of palms and their localities derived from reports of members who have visited there. Members are invited to send such information as they have to the California secretary. Those wishing to obtain the list upon its completion may do so by sending the secretary a stamped, self-addressed envelope.

* * *

California members viewed The Palm Society's collection of slides Sunday, March 27th, at the Arboretum in Arcadia. All California members wishing to be notified of future local activities should send several self-addressed postal cards to the secretary.

MRS. G. F. HERMAN
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Oregon Trachycarpus and the Weather

ROBERT L. BISHOP

The three palms in the accompanying photographs have been tentatively identified as *Trachycarpus Fortunei*. They are located in Portland and nearby Oregon City. These three palms have endured winter temperature extremes far beyond anything experienced by most "palmateers" of southern California or Florida. In fact they have survived severities of cold that have felled many a plant of sturdier reputation.

Figure 35 shows my 11-year-old daughter Barbara depicting the relative comparative size of this palm. This photograph was made in January 1957 on the morning after the coldest night of the year. The mercury fell to 6°F. and was 12°F. when this picture was made at 10 a.m. the following morning. According to Mrs. Alvin Miller who, with her husband, manages the apartment building, the age of the palm can only be guessed at something less than the age of the building, probably 35 to 40 years.

The palm in figure 36 is also about 35 years of age, and it is the surviving specimen of two planted by the late Dr. F. H. Dammasch of Portland. Mrs. Dammasch was most informative and related how her husband had purchased two small potted palms from a florist

35. The author's daughter shivers under *Trachycarpus Fortunei* in 12° temperature.

shop. When they became too large to handle easily they were set out of doors. Though he carefully covered them during cold spells, one of the pair succumbed to freezing temperatures. I was also shown photographs made about ten years ago, when this palm presented a more thrifty appearance than it does now. At that time the crown of leaves was still below the eave gutters of the house, the leaves on the lower stalks touching the ground much in the manner as the palm in figure 37. This has led me to believe that perhaps the windmill palm should be protected from the wind as much as possible in order to insure a luxuriant appearance.

The palm in figure 37 is the most healthy appearing of the trio, possibly because of its sheltered position situated in nearly perpetual shade. This palm is in historic Oregon City, 400 feet above the great falls of the Willamette River and lying in nearly line of sight view of the rugged Cascade Range 40 miles to the east. It too was purchased as a small potted palm 20 years ago by Mrs. J. Maddax while on a visit to Sacramento, Cal. She kept it on the porch of her home, taking it indoors in winter until becoming of such size that it was finally planted in the yard, without too much hope for its survival. It is not nearly as tall as the others, about ten to twelve feet.

In November of 1955 occurred one of the most severe freezes on record here in Oregon, not that temperatures were extremely low by past comparisons of cold. Temperatures dropped suddenly from the mild fifties of November to 15 and 20 degrees Fahrenheit and remained continuously below the freezing mark for an entire week. The resulting damage to plant life was catastrophic. Mrs. Maddax's palm was completely defoliated and the remaining end of the trunk became a soft mushy pulp. A similar sized *Trachycarpus* a few blocks away was considered lost by its owner and promptly cut down (probably the only other palm in Oregon City).

This same freeze did many thousands of dollars damage to the commercial walnut and filbert orchards, completely destroying some. Ornamental evergreens also suffered heavy damage, including a few native species of trees. In spite of dire predictions by the local press, most plants did recover, the most remarkable being the *Trachycarpus* palms. Today, three years later, Mrs. Maddax's palm (figure 37) is a striking specimen, showing not the slightest sign of frost damage.

Aside from sudden heavy freezes such as the one just described, the lowest possible temperature that may occur in a

36. *Trachycarpus Fortunei* about 35 years old in Portland, Oregon.

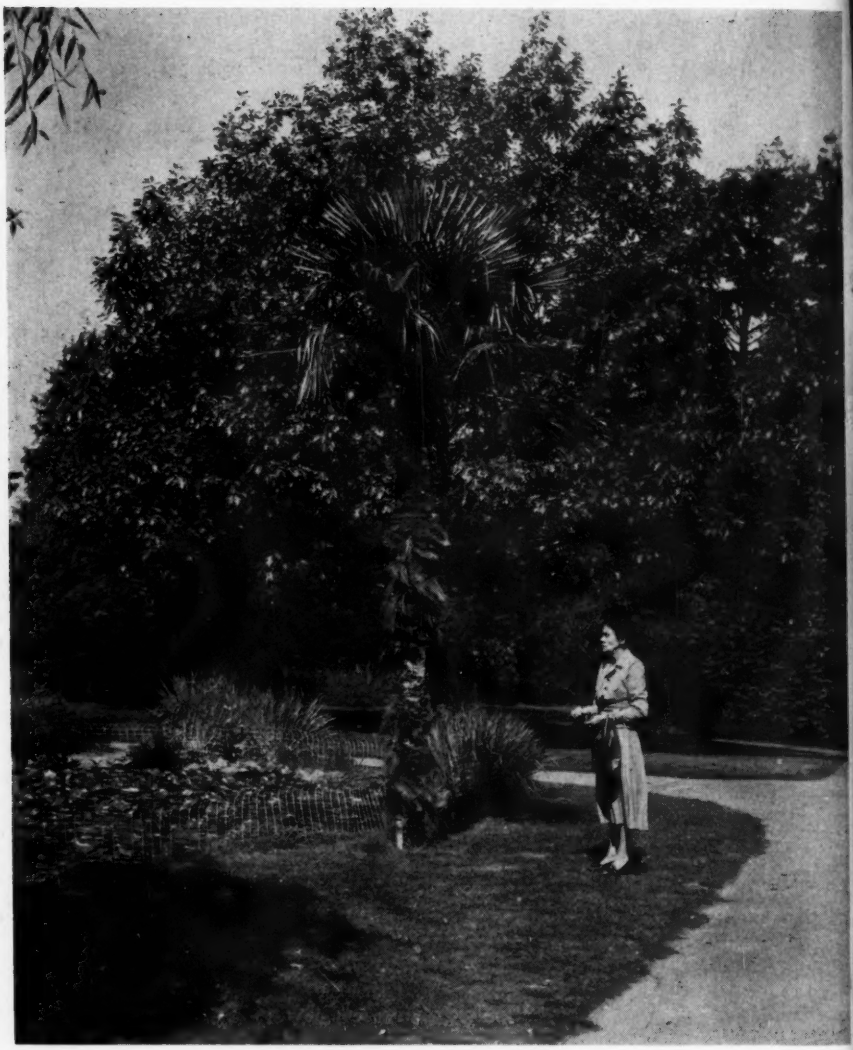
particular region is generally the factor that determines a palm's hardiness. Checking back through the U.S. Weather Bureau records for the extreme low temperature reading of each year, I found that the lowest temperature ever recorded by the Portland office was in 1950. The mercury fell that year to a −3°F. This was the record all time low since the station began its operation 86 years ago. The only other below zero reading was made in 1888, when it was −2°F.

It soon became apparent that not only has winter weather been typical during the lifespan of these three palms, but the most severe has also occurred. The greatest single snowfall happened on a January night in 1937 when 16 inches fell so unexpectedly that it virtually paralyzed the city the following morning. Two of the palms were only about ten years of age at this time.

The average winter in Portland produces two or three light snowfalls, seldom over six inches in depth at one time, and always melting completely within two or three days. Temperatures usually range from 15 to 20 degrees Fahrenheit during the course of these snows. When it becomes extremely cold in Portland it is always in company with clear skies and a complete absence of precipitation, though the soil may be well saturated by previous rain.

The *Trachycarpus Fortunei* or windmill palm is seldom seen on the Pacific coast north of Redding, California. It is a palm which deserves to be more widely planted, especially in those regions where palms are grown and liable to severe injury by freak frosts.

37. Sheltered and shaded *Trachycarpus Fortunei* thrives in Oregon City, Oregon.



38. *Trachycarpus* in Beacon Hill Park, Victoria, British Columbia, Canada. There are two of these, the smaller not pictured here. The two specimens were planted over 25 years ago. The local weather station, which has been in existence 60 years, advised me that the 60-year absolute minimum temperature occurred in January 1950, when 6.4° F. was recorded. (It has been colder than this in the state of Florida!) The two palms are the northernmost cultivated specimens in the Western Hemisphere—or else a reasonable facsimile thereof. There are no palms at Butchart Gardens north of Victoria. Photograph and notes by Dent Smith.